What is claimed is:

1. A pattern generation system which generates beam control data for causing at least one beam to image a pattern on a target, said pattern generation system comprising:

a data generation subsystem configured to generate and assert a set of hierarchical image data having at least three levels of hierarchy, wherein the hierarchical image data includes residual data and a set of cells, each of the cells determines a feature set of the pattern, the residual data includes at least two subroutine call commands, and each of the subroutine call commands identifies a cell of the set of cells and a portion of the target at which the feature set determined by the cell is to be imaged; and

a graphics engine having a memory, wherein the graphics engine is coupled and configured to receive the hierarchical image data, to store the set of cells upon receiving the hierarchical image data, and to generate the beam control data in response to the residual data and the contents of the memory, wherein the graphics engine is configured to respond to each of at least two of the subroutine call commands by retrieving one of the cells from the memory and generating a portion of the beam control data which controls imaging of the feature set determined by said one of the cells at the portion of the target identified by said each of at least two of the subroutine call commands,

wherein the set of cells includes at least one primary cell and at least one secondary cell, the subroutine call commands include at least two primary call commands and at least two secondary call commands, the primary cell includes said at least two secondary call commands, the graphics engine is configured to respond to each of at least two of the primary call commands by retrieving the primary cell from the memory and generating a portion of the beam control data which controls imaging of the feature set determined by the primary cell at the portion of the target identified by said each of at least two of the primary call

commands, and the graphics engine is configured to respond to each of at least two of the secondary call commands by retrieving the secondary cell from the memory and generating a portion of the beam control data which controls imaging of the feature set determined by the secondary cell at the portion of the target identified by said each of at least two of the secondary call commands.

2. The system of claim 1, wherein the beam control data is in pixel format.

3. The system of claim 1, also including:

a beam system, coupled to receive the beam control data from the graphics engine and configured to image the pattern on the target in response to the beam control data, wherein the beam system is configured to respond to the beam control data by operating in a sequence of configurations which cause the at least one beam to image the pattern on the target.

4. The system of claim 3, wherein the graphics engine is a raster engine, and wherein the beam system is configured to respond to the beam control data by executing a raster scan of the at least one beam relative to the target.

5. The system of claim 1, wherein the data generation subsystem includes a processor programmed to generate the set of hierarchical image data in response to a set of hierarchical raw image data, wherein the processor is programmed with software for:

determining a hierarchy graph for the raw image data, identifying said hierarchy graph as a tentative hierarchy graph of a tentative version of the hierarchical image data, sorting cells of the tentative hierarchy graph according to a figure of merit, and classifying the cells of the tentative hierarchy graph into a first cell set and a second cell set such that each cell in the first cell set satisfies at least one predetermined criterion including the criterion that the

figure of merit of each cell of the first cell set has a predetermined relation to a threshold value, and second cell set consists of each of the cells that is not in the first cell set; and

determining the hierarchical image data from the hierarchical raw image data by replacing the second cell set and the subroutine calls to each cell in the second cell set with replacement residual data, such that the hierarchy graph of the hierarchical image data includes the first cell set but not the second cell set, and the residual data of the hierarchical image data includes the replacement residual data.

6. The system of claim 1, wherein the data generation subsystem includes a processor programmed to generate the set of hierarchical image data in response to a set of hierarchical raw image data, wherein the processor is programmed with software for:

determining a hierarchy graph for the raw image data, identifying said hierarchy graph as a tentative hierarchy graph of a tentative version of the hierarchical image data, and sorting cells of the tentative hierarchy graph according to their individual size relative to total size of the set of raw image data;

identifying one of the cells of the tentative hierarchy graph whose size is largest relative to the total size of the tentative version of the hierarchical image data, and if the size of said one of the cells does not exceed a cachable size, determining whether inclusion of said one of the cells as a cell of the hierarchical image data would cause the size of the residual portion of the hierarchical image data to exceed a predetermined maximum size; and

if inclusion of said one of the cells as a cell of the hierarchical image data would cause the size of the residual portion of the hierarchical image data to exceed the predetermined maximum size, identifying a new cell that contains multiple instantiations of said one of the cells and has size that does not exceed the cachable size, updating the tentative hierarchy graph and the tentative

version of the hierarchical image data by replacing the multiple instantiations of said one of the cells with said new cell, thereby determining an updated hierarchy graph and an updated version of the hierarchical image data, and if the size of the residual portion of the updated hierarchical image data does not exceed the predetermined maximum size, identifying the updated hierarchical image data as the hierarchical image data.

7. A graphics engine which generates beam control data for causing at least one beam to image a pattern on a target, said graphics engine comprising:

a memory coupled to receive a set of hierarchical image data having at least three levels of hierarchy, wherein the hierarchical image data includes residual data and a set of cells, each of the cells determines a feature set of the pattern, the residual data includes at least two subroutine call commands, and each of the subroutine call commands identifies a cell of the set of cells and a portion of the target at which the feature set determined by the cell is to be imaged, and wherein the engine is configured to store the set of cells in the memory upon receiving the hierarchical image data; and

a beam control data generator coupled to the memory, wherein the beam control data generator is coupled to receive at least the residual data of the hierarchical image data and configured to generate the beam control data in response to the residual data and the contents of the memory, and wherein the beam control data generator is configured to respond to each of at least two of the subroutine call commands by retrieving one of the cells from the memory and generating a portion of the beam control data which controls imaging of the feature set determined by said one of the cells at the portion of the target identified by said each of at least two of the subroutine call commands,

wherein the set of cells includes at least one primary cell and at least one secondary cell, the subroutine call commands include at least two primary call commands and at least two secondary call commands, the primary cell includes said at least two secondary call commands, the beam control data generator is

configured to respond to each of at least two of the primary call commands by retrieving the primary cell from the memory and generating a portion of the beam control data which controls imaging of the feature set determined by the primary cell at the portion of the target identified by said each of the primary call commands, and the beam control data generator is configured to respond to each of at least two of the secondary call commands by retrieving the secondary cell from the memory and generating a portion of the beam control data which controls imaging of the feature set determined by the secondary cell at the portion of the target identified by said each of at least two of the secondary call commands.

8. The engine of claim 7, wherein the beam control data is in pixel format.

9. A pattern generation system which generates beam control data for causing at least one beam to image a pattern on a target, said pattern generation system comprising:

a data generation subsystem configured to generate and assert a set of hierarchical image data having at least three levels of hierarchy, wherein the hierarchical image data includes residual data and cells, the cells include at least one primary cell determining a feature set of the pattern and at least one secondary cell determining a feature set of the pattern, the residual data includes at least two subroutine call commands for each of the cells, and each of the subroutine call commands identifies one of the cells and a portion of the target at which the feature set determined by said one of the cells is to be imaged; and

a graphics engine having a memory, wherein the graphics engine is coupled and configured to receive the hierarchical image data, to generate and store in the memory a beam control data cell in response to each of the cells of the hierarchical image data, and to generate the beam control data in response to the residual data and the contents of the memory, and wherein the graphics

engine is configured to respond to each of the subroutine call commands by retrieving one said beam control data cell from the memory.

10. The system of claim 9, wherein the beam control data is in pixel format.

11. The system of claim 9, also including:

a beam system, coupled to receive the beam control data from the graphics engine and configured to image the pattern on the target in response to the beam control data, wherein the beam system is configured to respond to the beam control data by operating in a sequence of configurations which cause the at least one beam to image the pattern on the target.

12. The system of claim 11, wherein the graphics engine is a raster engine, and wherein the beam system is configured to respond to the beam control data by executing a raster scan of the at least one beam relative to the target.

13. A graphics engine which generates beam control data for causing at least one beam to image a pattern on a target, said graphics engine comprising:

a memory; and

a beam control data generator coupled to the memory and to receive a set of hierarchical image data having at least three levels of hierarchy, wherein the hierarchical image data includes residual data and cells, the cells include at least one primary cell determining a feature set of the pattern and at least one secondary cell determining a feature set of the pattern, the residual data includes at least two subroutine call commands for each of the cells, and each of the subroutine call commands identifies one of the cells and a portion of the target at which the feature set determined by said one of the cells is to be imaged, wherein the beam control data generator is configured to generate and store in

the memory a beam control data cell in response to each of the cells, and to generate the beam control data in response to the residual data and the contents of the memory, and wherein the beam control data generator is configured to respond to each of at least two of the subroutine call commands by retrieving one said beam control data cell from the memory.

14. The engine of claim 13, wherein the beam control data is in pixel format.

15. A processor programmed to generate a set of hierarchical image data having at least two levels of hierarchy in response to a set of hierarchical raw image data, such that the hierarchical image data includes residual data and at least one cell, each said cell determines a feature set of a pattern, the residual data includes at least two subroutine call commands, and each of the subroutine call commands identifies a cell of said at least one cell and a portion of a target at which the feature set determined by the cell is to be imaged, wherein the processor is programmed with software for:

(a) determining a hierarchy graph for the raw image data, identifying said hierarchy graph as a tentative hierarchy graph of a tentative version of the hierarchical image data, sorting cells of the tentative hierarchy graph according to a figure of merit, and classifying the cells of the tentative hierarchy graph into a first cell set and a second cell set such that each cell in the first cell set satisfies at least one predetermined criterion including the criterion that the figure of merit of each cell of the first cell set has a predetermined relation to a threshold value, and second cell set consists of each of the cells that is not in the first cell set; and

(b) determining the hierarchical image data from the hierarchical raw image data by replacing the second cell set and the subroutine calls to each cell in the second cell set with replacement residual data, such that the hierarchy graph of the hierarchical image data includes the first cell set but not the second

cell set, and the residual data of the hierarchical image data includes the replacement residual data.

16. The processor of claim 15, wherein said processor is programmed with software for classifying the cells of the tentative hierarchy graph into the first cell set and the second cell set such that the figure of merit of each cell of the first cell set exceeds the threshold value and the figure of merit of each cell of the second cell set does not exceed the threshold value.

17. The processor of claim 16, wherein the cells of the hierarchical image data are to be cached in a memory of a graphics engine, and the figure of merit for each cell is the size of that portion of the memory that would be occupied by said cell if said cell were cached in said memory.

18. The processor of claim 16, wherein the hierarchical image data is to be transferred to the graphics engine, the cells of the hierarchical image data are to be cached in a memory of the graphics engine, and the figure of merit for each cell is SAV/SIZE, where SIZE is the size of that portion of the memory that would be occupied by the cell if said cell were cached in said memory, and SAV is the data volume by which the overall volume of the hierarchical image data is reduced by including said cell in the hierarchical image data, along with subroutine call commands for repeatedly calling said cell after it has been cached in the memory, in place of residual data corresponding to said cell.

19. A processor programmed to generate a set of hierarchical image data having at least two levels of hierarchy in response to a set of hierarchical raw image data, such that the hierarchical image data includes residual data and a set of cells, each of the cells determines a feature set of a pattern, the residual data includes at least two subroutine call commands, and each of the subroutine call commands identifies a cell of the set of cells and a portion of a target at

which the feature set determined by the cell is to be imaged, wherein the processor is programmed with software for:

(a) determining a hierarchy graph for the raw image data, identifying said hierarchy graph as a tentative hierarchy graph of a tentative version of the hierarchical image data, and sorting cells of the tentative hierarchy graph according to their individual size relative to total size of the set of raw image data;

(b) identifying one of the cells of the tentative hierarchy graph whose size is largest relative to the total size of the tentative version of the hierarchical image data, and if the size of said one of the cells does not exceed a cachable size, determining whether inclusion of said one of the cells as a cell of the hierarchical image data would cause the size of the residual portion of the hierarchical image data to exceed a predetermined maximum size; and

(c) if inclusion of said one of the cells as a cell of the hierarchical image data would cause the size of the residual portion of the hierarchical image data to exceed the predetermined maximum size, identifying a new cell that contains multiple instantiations of said one of the cells and has size that does not exceed the cachable size, updating the tentative hierarchy graph and the tentative version of the hierarchical image data by replacing the multiple instantiations of said one of the cells with said new cell, thereby determining an updated hierarchy graph and an updated version of the hierarchical image data, and if the size of the residual portion of the updated hierarchical image data does not exceed the predetermined maximum size, identifying the updated hierarchical image data as the hierarchical image data.

20. A method for generating a set of hierarchical image data having at least two levels of hierarchy in response to a set of hierarchical raw image data, such that the hierarchical image data includes residual data and a set of cells, each of the cells determines a feature set of a pattern, the residual data includes at least two subroutine call commands, and each of the subroutine call

commands identifies a cell of the set of cells and a portion of a target at which the feature set determined by the cell is to be imaged, said method including the steps of:

(a) determining a hierarchy graph for the raw image data, identifying the hierarchy graph as a tentative hierarchy graph of a tentative version of the hierarchical image data, and sorting cells of the tentative hierarchy graph according to their individual size relative to total size of the set of raw image data;

(b) identifying one of the cells of the tentative hierarchy graph whose size is largest relative to the total size of the tentative version of the hierarchical image data, and if the size of said one of the cells does not exceed a cachable size, determining whether inclusion of said one of the cells as a cell of the hierarchical image data would cause the size of the residual portion of the hierarchical image data to exceed a predetermined maximum size; and

(c) if inclusion of said one of the cells as a cell of the hierarchical image data would cause the size of the residual portion of the hierarchical image data to exceed the predetermined maximum size, identifying a new cell that contains multiple instantiations of said one of the cells and has size that does not exceed the cachable size, updating the tentative hierarchy graph and the tentative version of the hierarchical image data by replacing the multiple instantiations of said one of the cells with said new cell, thereby determining an updated hierarchy graph and an updated version of the hierarchical image data, and if the size of the residual portion of the updated hierarchical image data does not exceed the predetermined maximum size, identifying the updated hierarchical image data as the hierarchical image data.

21. A method for generating a set of hierarchical image data to be transferred to a graphics engine, in response to a set of hierarchical raw image data, such that the hierarchical image data has at least two levels of hierarchy and includes residual data and a set of cells, each of the cells determines a

feature set of a pattern, the residual data includes at least two subroutine call commands, and each of the subroutine call commands identifies a cell of the set of cells and a portion of a target at which the feature set determined by the cell is to be imaged, said method including the steps of:

determining a hierarchy graph for the raw image data, and determining a tentative version of the hierarchical image data having said hierarchy graph; and

modifying the tentative version of the hierarchical image data to determine an optimized version of the hierarchical image data which achieves an optimal combination of reduced data volume relative to the data volume of the raw image data, and reduced time required for generation of beam control data from the optimized hierarchical image data in the graphics engine relative to the time required for generation of the beam control data from the raw image data in the graphics engine.

22. A method for generating a set of hierarchical image data having at least two levels of hierarchy in response to a set of hierarchical raw image data, such that the hierarchical image data includes residual data and at least one cell, each said cell determines a feature set of a pattern, the residual data includes at least two subroutine call commands, and each of the subroutine call commands identifies a cell of said at least one cell and a portion of a target at which the feature set determined by the cell is to be imaged, said method including the steps of:

(a) determining a hierarchy graph for the raw image data, identifying said hierarchy graph as a tentative hierarchy graph of a tentative version of the hierarchical image data, sorting cells of the tentative hierarchy graph according to a figure of merit, and classifying the cells of the tentative hierarchy graph into a first cell set and a second cell set such that each cell in the first cell set satisfies at least one predetermined criterion including the criterion that the figure of merit of each cell of the first cell set has a predetermined relation to a threshold value, and second cell set consists of each of the cells that is not in the

first cell set; and

(b) determining the hierarchical image data from the hierarchical raw image data by replacing the second cell set and the subroutine calls to each cell in the second cell set with replacement residual data, such that the hierarchy graph of the hierarchical image data includes the first cell set but not the second cell set, and the residual data of the hierarchical image data includes the replacement residual data.

23. A method for generating beam control data for causing at least one beam to image a pattern on a target, said method comprising the steps of:

(a) generating a set of hierarchical image data having at least three levels of hierarchy, wherein the hierarchical image data includes residual data and a set of cells including at least one primary cell determining a feature set of the pattern and at least one secondary cell determining a feature set of the pattern, the residual data includes primary subroutine call commands, the primary cell includes at least two secondary subroutine call commands, each of the subroutine call commands identifies a cell of the set of cells and a portion of the target at which the feature set determined by the cell is to be imaged;

(b) storing each of the cells in a memory; and

(c) generating the beam control data in response to the residual data and the contents of the memory, including by responding to each of at least two of the primary call commands by retrieving the primary cell from the memory and generating a portion of the beam control data which controls imaging of the feature set determined by the primary cell at the portion of the target identified by said each of at least two of the primary call commands, and responding to each of at least two of the secondary call commands by retrieving the secondary cell from the memory and generating a portion of the beam control data which controls imaging of the feature set determined by the secondary cell at the portion of the target identified by said each of at least two of the secondary call commands.

24. The method of claim 23, wherein step (c) is performed such that the beam control data is in pixel format.

25. The method of claim 23, also including the step of:

(d) in response to the beam control data, operating a beam system in a sequence of configurations which cause the at least one beam to image the pattern on the target.

26. The method of claim 25, wherein the beam system executes a raster scan of the at least one beam relative to the target during step (d).

27. A method for generating beam control data for causing at least one beam to image a pattern on a target, said method comprising the steps of:

(a) operating a graphics engine to receive a set of hierarchical image data having at least three levels of hierarchy and comprising a set of cells including at least one primary cell determining a feature set of the pattern and at least one secondary cell determining a feature set of the pattern, and residual data, and to store the primary cell and the secondary cell in a memory, wherein the residual data includes primary subroutine call commands, and the primary cell includes secondary call commands, wherein each of the subroutine call commands identifies one of the cells and a portion of the target at which the feature set determined by said one of the cells is to be imaged; and

(b) operating the graphics engine to generate the beam control data in response to the residual data and the contents of the memory, including by responding to each of at least two of the primary call commands by retrieving the primary cell from the memory and generating a portion of the beam control data which controls imaging of the feature set determined by the primary cell at the portion of the target identified by said each of at least two of the primary call commands, and responding to each of at least two of the secondary call

commands by retrieving the secondary cell from the memory and generating a portion of the beam control data which controls imaging of the feature set determined by the secondary cell at the portion of the target identified by said each of at least two of the secondary call commands.

28. The method of claim 27, wherein step (b) is performed such that the beam control data is in pixel format.

29. The method of claim 27, also including the step of:

(c) in response to the beam control data, operating a beam system in a sequence of configurations which cause the at least one beam to image the pattern on the target.

30. The method of claim 29, wherein the beam system executes a raster scan of the at least one beam relative to the target during step (c).

31. A method for generating beam control data for causing at least one beam to image a pattern on a target, said method comprising the steps of:

(a) operating a graphics engine to receive a set of hierarchical image data having at least three levels of hierarchy and cells including at least one primary cell and at least one secondary cell, and to generate and store in a memory a beam control data cell in response to each said primary cell and each said secondary cell of the hierarchical image data, wherein the hierarchical image data also includes residual data including subroutine call commands, and each of the subroutine call commands identifies one said beam control data cell and a portion of the target at which a feature set determined by said beam control data cell is to be imaged; and

(b) operating the graphics engine to generate the beam control data in response to the residual data and the contents of the memory, including by responding to each of at least two of the subroutine call commands by retrieving

one said beam control data cell from the memory.

32. The method of claim 31, wherein step (b) is performed such that the beam control data is in pixel format.

33. The method of claim 32, also including the step of:

(c) in response to the beam control data, operating a beam system in a sequence of configurations which cause the at least one beam to image the pattern on the target.

34. The method of claim 33, wherein the beam system executes a raster scan of the at least one beam relative to the target during step (c).